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Indian Standard

SPECIFICATION FOR METAL-CLAD BASE MATERIALS FOR PRINTED CIRCUITS FOR USE IN ELECTRONIC AND TELECOMMUNICATION EQUIPMENT

PART III PHENOLIC CELLULOSE PAPER COPPER-CLAD LAMINATED SHEET PF-CP-Cu (HIGH ELECTRIC GRADE)

UDC 621·3·049·75 : 621·315·619-419 : 621·38/·39·038

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PART III PHENOLIC CELLULOSE PAPER COPPER-CLAD LAMINATED SHEET PF-CP-Cu (HIGH ELECTRIC GRADE)

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(*Continued on page 2*)

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SPECIFICATION FOR METAL-CLAD BASE MATERIALS FOR PRINTED CIRCUITS FOR USE IN ELECTRONIC AN-D TELECOMMUNICATION EQUIPMENT

PART III PHENOLIC CELLULOSE PAPER COPPER-CLAD LAMINATED SHEET PF-CP-Cu (HIGH ELECTRIC GRADE)

0. FOREWORD

0.1 This Indian Standard (Part III) was adopted by the Indian Standards Institution on 26 May 1978, after the draft finalized by the Printed Circuits Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard is to be used in conjunction with IS : 5921 (Part I) - 1970* which is a necessary adjunct to this standard.

0.3 While preparing this standard, assistance has been derived from the following:

IEC Pub 249-2 (1970) ‘ Metal-clad base materials for printed circuits: Part 2 Specifications’. International Electrotechnical Commission.

IEC Pub 249-2B (1973) Second supplement to Pub 249-2 (1970).

BS 4584 Part 7 : 1972 Specification for metal clad base materials for printed circuits, Part 7 Phenolic cellulose paper copper-clad laminated sheet of high electrical quality: PF: CP-Cu-7. British Standards Institution.

NEMA: Industrial laminated thermosetting products LI-1-1971. National Electrical Manufacturers’ Association, U. S. A.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Specification for metal-clad base materials for printed circuits for use in electronic and telecommunication equipment: **Part I** General requirements and tests.

†Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part III) specifies the requirements for phenolic cellulose paper copper clad laminated sheet, high electrical grade for use in printed wiring in telecommunication and allied electronic equipment.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions of terms given in IS : 1885 (Part VI)-1978* shall apply.

3. MATERIALS, CONSTRUCTION AND WORKMANSHIP

3.1 Materials and Construction — The sheet shall consist of an insulating base with copper foil bonded to one or both sides.

3.1.1 *Base Material* — It shall be phenolic resin bonded cellulose paper laminate.

3.1.2 Copper — Copper used shall conform to the requirements specified in Table 1.

NOTE — For information only:

Minimum purity of the copper foil:	**99.5 percent (for determination of minimum purity of copper *see* IS : 440-1964†)**
Minimum conductivity:	**95 percent of the value equivalent to a resistivity of $1\cdot724\times10^{-8}$ Ωm at 20°C**

TABLE 1 MASS AND THICKNESS OF COPPER

NOMINAL MASS/ UNIT AREA	DEVIATION	NOMINAL THICKNESS	DEVIATION FOR THICKNESS OF THE FOIL AT ANY POINT
(1)	(2)	(3)	(4)
g/m²	percent	µm	µm
305	± 15	35	+ 10 - 5
610	± 15	70	+ 18 — 8

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*Electrotechnical vocabulary: Part VI Printed circuits (*first* revision).

†Methods of chemical analysis of copper (*revised*).

3.2 Workmanship — Provisions of 3.2 of IS : 5921 (Part I)-1970* shall apply.

4. MARKING

4.1 The marking shall be in black or in some other colour not to be confused with red colour and shall conform to 4 of IS: 5921 (Part I)-1970*.

NOTE — Red indicates the flame resistant grade.

4.2 The marking shall be printed so as to indicate the machine direction of the filling material (cellulose paper).

5. TESTS

5.1 Classification of Tests — The provisions of 5.1 of IS : 5921 (Part I)-1970* shall apply except as modified by 5.1.1.

5.1.1 *Acceptance Tests* — Unless and otherwise specified the acceptance tests shall be carried out on a limited number of samples that have passed the routine tests. Three groups of samples (A, B, and C) shall be selected (see IS :2612-1964†) and the samples in each group shall be subjected to the tests specified in Table 2 in the order given. The acceptance criteria shall be as specified in the table:

TABLE 2 SCHEDULE OF ACCEPTANCE TESTS

SL No.	TEST	AQL* (PERCENTAGE DEFECTIVE)	INSPECTION LEVEL
(1)	(2)	(3)	(4)
i)	**Group A Tests**		
	a) General Examination Dimensions and Tolerances (length and width)	4	II
	b) Thickness c) Bow d) Twist	1	II
ii)	**Groups B Tests**		
	a) Peel strength of 25 mm strip (Method A) b) Solder float	6.5	S_2
iii)	**Group C Tests**		
	Surface resistance and volume resistivity	6·5	S_2

*See IS : 2500 (Part I)-1973 Inspection by attributes and by count of defects (*first* revision).

5.2 **Conditions of Tests** — The provisions of 5.2 of IS : 5921 (Part I)-1970* shall apply.

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*Specification for metal-clad base materials for printed circuits for use in electronic and telecommunication equipment: Part I General requirements and tests.

†Recommendation for type approval and sampling procedures for electronic components.

5.3 Test Schedule — The test schedule for type approval specifying all the tests and the order in which they shall be carried out as well as the requirements to be met with, shall be as specified in Table 3.

NOTE — The clause references, conditions of test and requirements specified are applicable for the acceptance tests also.

TABLE 3 TEST SCHEDULE AN-D REQUIREMENTS

SL No.	TEST	REFERENCE TO CL NO. OF IS:5921 (PART I)-1970*	CONDITION OF TEST	REQUIREMENTS
(1)	(2)	(3)	(4)	(5)
i)	General examination	5.3.1	As received	*Appearance of the copper clad face* — The surface condition shall be such that the defects, if present, can be clearly observed. The metal surface shall be free from blisters, wrinkles, and scratches of depth greater than 25 percent of the thickness of the foil. The permissible number of defects on a sheet shall not exceed those given in Table 2 of IS : 5921 (Part I)-1970*. Any discolouration or contamination shall be readily removable with a hydrochloric acid solution (sp gr 1·02) or with a suitable organic solvent
ii)	Thickness	5.3.3.2	As received	The thickness of the sheet including the metal foil shall not depart at any point from the nominal thickness by more than the appropriate value shown below:

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*Specification for metal-clad base materials for printed circuits for use in electronic and telecommunication equipment: Part I General requirements and tests.

(*Continued*)

TABLE 3 TEST SCHEDULE AND REQUIREMENTS — *Contd*

<table>
<tr><th>Sl No.</th><th>Test</th><th>Reference to Cl No. of IS : 5921 (Part I)-1970*</th><th>Condition of Test</th><th>Requirements</th></tr>
<tr><th>(1)</th><th>(2)</th><th>(3)</th><th>(4)</th><th>(5)</th></tr>
<tr><td></td><td></td><td></td><td></td><td>
<table>
<tr><th>Nominal Thickness mm</th><th>Tolerance ± mm</th></tr>
<tr><td>0·8</td><td>0.09</td></tr>
<tr><td>†1·0</td><td>0·11</td></tr>
<tr><td>†1·2</td><td>0·12</td></tr>
<tr><td>1·6</td><td>0·14</td></tr>
<tr><td>†2·0</td><td>0·15</td></tr>
<tr><td>2·4</td><td>0·18</td></tr>
<tr><td>3·2</td><td>0·20</td></tr>
<tr><td>6·4</td><td>0·30</td></tr>
</table>
NOTE — For any nominal thickness within the range of nominal thickness 0·8 to 6·4 mm, which is not given in the table of nominal thickness and corresponding tolerances, the tolerances applicable to the thickness shall be that for the next greater nominal thickness given in the table, for thickness more than 6·4 mm, to be agreed between the purchaser and the manufacturer</td></tr>
<tr><td>iii)</td><td>Length and width</td><td>5.3.3.1</td><td>As received</td><td>The minimum width and length of the sheet shall be 1.25 m and 0·45 m respectively with tolerance off 25 mm for each side
For cut sizes smaller than the above, the tolerances shall be as agreed between the customer and the manufacturer</td></tr>
</table>

*Specification for metal-clad base materials for printed circuits for use in electronic and telecommunication equipment: Part I General requirements and tests.

†Non-preferred values.

(*Continued*)

TABLE 3 TEST SCHEDULE AND REQUIREMENTS — *Contd*

Sl No.	Test	Reference to Cl No. of IS : 5921 (Part I)-1970*	Condition of Test	Requirements
(1)	(2)	(3)	(4)	(5)
iv)	Bow	5.3.4	As received	This shall not exceed the value given by the formula $d(L/1\,000)^2$ mm where, L is the length of the straight edge in millimetres, d *is as* given below:

Nominal Thickness, mm	35 & 70 pm Copper foil on one side d	35 & 70 µm Copper foil on both sides d
Less than 0·8	Not applicable	
0·8 to 1·2	109	55
above 1·2 to 1·6	55	27
above 1·6 to 3·2	55	27
above 3·2 to 6·4	55	15

Sl No.	Test	Reference to Cl No. of IS : 5921 (Part I)-1970*	Condition of Test	Requirements
v)	Twist	5.3.7	As received	Shall not exceed the value given by the formula $d(L/1\,000)^2$ mm where L is the distance in millimetres between the corner of the sheet not in contact with the horizontal surface and the diagonally opposite corner, d is as given in the above table The requirements for bow and twist apply only to sheet sizes as manufactured and to cut pieces having neither length nor width less than 450 mm

*Specification for metal-clad base materials for printed circuits for use in electronic and telecommunication equipment: Part I General requirements and tests.

(*Continued*)

TABLE 3 TEST SCHEDULE AND REQUIREMENTS — *Contd*

SL No.	TEST	REFERENCE TO CL No. OF IS : 5921 (PART I)-1970*	CONDITION OF TEST	REQUIREMENTS
(1)	(2)	(3)	(4)	(5)
				For smaller cut sizes, the requirements shall bc as agreed between the purchaser and the manufacturer
vi)	Hot solder resistance	As per method given in Appendix A	Temperature 260^{+5}_{-0} °C Time 5 s	Shall show no delamination and blistering on copper surface
vii)	Pull off strength	5.3.9	—	Not less than 50 N
viii)	Peel strength	5.3.10.1 (Method A)	—	25 N/25 mm
ix)	Peel strength after heat shock	5.3.10.2 As modified by Appendix A	Temperature of bath 260^{+5}_{-0} °C Time 5 s	There shall be no delamination and the peel strength shall be not less than 1 N/mm
x)	Peel strength after dry heat	5.3.10.3	Temperature 100 ± 2°C Time 1 hour	Not less than 1N/mm
xi)	Peel strength after exposure to simulated plating conditions	5.3.10.5	—	Not less than 0·6 N/mm
xii)	Peel strength after exposure to solvent vapour (trichloroethylene)	5.3.10.4		Not less than 1 N/mm
xiii)	Solderability	5.4.8	—	The soldered area shall be covered with a smooth and bright solder coating with not more than traces (approximately 5 percent) of scattered imperfections, such as pin-holes, unwetted or dewetted areas. These imperfections shall not be concentrated in one area. [see Fig. 8A of IS : 5921 (Part I)-1970*]

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*Specification for metal-clad base materials for printed circuits for use in electronic and telecommunication equipment: Part. I General requirements and tests.

(*Continued*)

TABLE 3 TEST SCHEDULE AND REQUIREMENTS —*Contd*

SL *No.*	TEST	REFERENCE TO CL NO. OF IS:5921 (PART I)-1970*	CONDITION OF TEST	REQUIREMENTS
(1)	(2)	(3)	(4)	(5)
xiv)	Punching quality	5.3.12	—	Under consideration
xv)	Resistance of foil	5.5.1	—	a) 305 g/m^2 — 3·5 m Ω, *Max* b) 610 g/m^2 —1·76 mΩ, *Max*
xvi)	Surface resistance after damp heat (long term) without recovery	5.5.2	4 days damp heat long term	1000 MΩ, *Min*
xvii)	Volume resistance after damp heat (long term) without recovery	5.5.3	4 days damp heat long term	10000 MΩ, *Min*
xviii)	Volume less tangent (tan δ at 1·0 MHz)	5.5.9	4 days damp heat long term after recovery	The average value shall not exceed 0·05 for sheet thickness not less than 0·5 mm
xix)	Volume permittivity at 1·0 MHz	5.5.9	4 days damp heat long term after recovery	The average value shall not exceed 5·5 for sheet thickness not less than 0·5 mm
xx)	Appearance of base material (after each removal of copper foil)	5.2.7.2	—	The base material shall be substantially free from pits, holes, scratches, porosity and resin inclusions and substantially uniform in colour. A small amount of irregular variation of colour is permissible
xxi)	**Flexural** strength	5.4.1	Applicable to sheet not less than 1·6 mm nominal thickness	8 000 M/cm^2

*Specification for metal-clad base materials for printed circuits for use in electronic and telecommunication equipment: Part I General requirements and tests.

(Continued)

TABLE 3 TEST SCHEDULE AND REQUIREMENTS — *Contd*

Sl No.	Test	Reference to Cl No. of IS : 5921 (Part I)-1970*	Condition of Test	Requirements	
(1)	(2)	(3)	(4)	(5)	
xxii)	Water absorption	5.4.7	—	Nominal Thickness	Water Absorption, *Max*, percent (on 50 x 50 mm)
				0·8	1·1
				1·0	0·98
				1·2	0.86
				1·6	0.74
				2·0	0.66
				2.4	0·62
				3.2	0·6
				6.4	0.37
				For any nominal thickness within the range of 0·8 to 6.4 mm, which is not given above, the water absorption applicable to the thickness shall be that for the next greater nominal thickness given above.	

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*Specification for metal-clad base materials for printed circuits for use in electronic and telecommunication equipment: Part I General requirements and tests.

APPENDIX A

(Clause 5.3 *and Item IX* of *Table 3*)

SOLDER FLOAT METHOD

A-1. DETAILS

A-1.1 The test specimens shall be 25 mm square. If the sheet under test is single sided copper-clad, 5 specimens are used. If the sheet under test is double sided copper-clad, 5 specimens are used for tests on one side and another 5 for other side.

A-1.2 A suitable solder bath of depth not less than 40 mm shall be used. If circular, the bath shall be not less than 120 mm in diameter, and if rectangular, not smaller than 100 mm x 75 mm. The bath shall contain solder of chemical composition and melting temperature range as specified in Appendix A of the draft Indian Standard ' Guidance on test for solderability and resistance to soldering heat ' (*under preparation*). It shall be protected from draughts.

A-1.3 The temperature of the solder shall be kept at the specified temperature throughout the test. The temperature shall be measured at a depth of 25 ± 2·5 mm below the surface with a calibrated thermocouple.

A-1.4 Specimens of metal-clad base material may be attached to the lower surface of a block of cork or other thermal insulation using drawing pins or other low mass holding device.

A-1.5 The specimens shall then be dropped with the metal clad side downwards, on to the surface of the clean molten solder for the time given in the relevant specification.

NOTE — For additional details of this test reference may be made to the draft Indian Standard on ' Basic environmental testing procedures for electronic and electrical items: Part......Solderability test ' (*under preparation*).

A-1.6 After removal from the solder bath, the specimen shall be examined for blisters or delamination. If it has not blistered or delaminated, it shall be allowed to cool to between 15" and 35°C and then used for the measurement of peel strength as described in 5.3.10.6 of IS : 5921 (Part I)-1970".

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*Metal-clad base materials for printed circuits for use in electronic and telecommunication equipment: Part I General requirements and tests.

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PRINTED CIRCUITS

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5921 (Part II)-1973	Metal-clad base materials for printed circuits for use in electronic and telecommunication equipment: Part II Paper phenolic copper-clad laminated sheet PF-CP-Cu economic grade
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